



North Dakota
LEGENDARY

RESEARCH NORTH DAKOTA

ANNUAL REPORT 2017

FUELING ECONOMIC GROWTH WITH RESEARCH & DEVELOPMENT PARTNERSHIPS



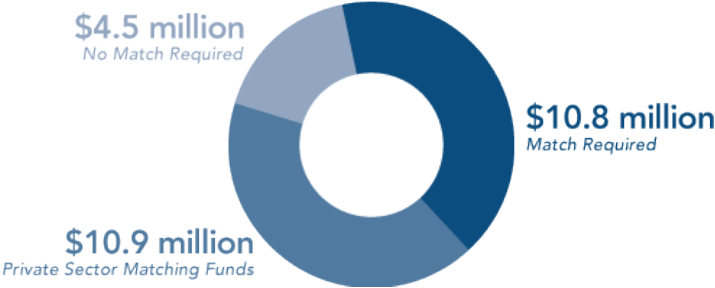
PROGRAM SUMMARY

Research North Dakota stimulates partnerships between North Dakota research universities and private sector businesses. It provides matching funds for the development and commercialization of products and processes through industry/research university projects.

RESEARCH ND INVESTMENT

State investment through June 30, 2017: \$15,382,426

Total public/private investment: \$26,296,807



FUNDS INVESTED TO DATE

Since the creation of Research North Dakota in 2013 by the State Legislature, \$15.38 million in state funds have been awarded for 84 projects. \$9.09 million of these funds have been disbursed to Research North Dakota recipients as of June 30, 2017.

MATCHING FUNDS

As of June 30, 2017, the Research North Dakota Grant recipients have obtained \$10.9 million in commitments of matching funds from private sector partners. The matching grants have a 1:1 private sector matching requirement.

The economic impact of private sector partners' activities in North Dakota is measured for five years after each project ends. As of June 30, 2017, nine projects were completed and 14 jobs were added with salary and benefits totaling \$693,000.

CENTER OF EXCELLENCE COMMISSION MEMBERS

The Centers of Excellence Commission oversees the administration of the Research North Dakota grant program. Research North Dakota includes three subprograms. These subprograms are Research ND (includes Fast Track), Research ND BIO, and Venture Grants (Phases I, II and I/II).

The Centers of Excellence Commission, with assistance from the North Dakota Department of Commerce, oversees the post-award monitoring of all Centers and grant recipients. The process includes biannual interim reports and final project reports from the research universities that describe the progress that has been made toward the commercialization of the product or process outlined in the application. All private sector partners are required to provide information used for economic impact analysis for five years after the project has ended.



NORTH DAKOTA ECONOMIC DEVELOPMENT FOUNDATION MEMBERS

- A. Tim Hennessy, Chairman
Regional President, US Bank, Bismarck
- B. Jim Traynor, Vice Chairman
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- C. Tommy Kenville, Owner
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NORTH DAKOTA BOARD OF HIGHER EDUCATION MEMBERS

- D. Mike Ness
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- E. Kevin Melicher, O.D.
Optometrist, Eyecare Associates, PC, Fargo
- F. Casey Ryan, M.D.
Altru Health System, Grand Forks



RESEARCH ND AWARDS

1:1 Match Required
2017-2019 Proposed Funding

Research ND funds can be used to commercialize new technologies, research and develop new products and improve existing products or processes.

VERIFY THE EFFECTIVENESS OF UAS-MOUNTED SENSORS IN FIELD CROP AND LIVESTOCK PRODUCTION MANAGEMENT

NDSU Department of Agricultural and Biosystems Engineering
Pulsar Operational Boundaries

Award to University: \$42,935 **Private-Sector Match: \$44,752** End Date: July 2016

To verify the effectiveness of UAS-mounted sensors in field crop and livestock production management.

LAW ENFORCEMENT UNMANNED AIRCRAFT SYSTEMS RESEARCH PROJECT

UND John D. Odegard School of Aerospace Sciences
AeroVironment

Award to University: \$35,466 **Private-Sector Match: \$35,550** End Date: August 2016

To study the effectiveness of AeroVironment's UAS platforms for use in law enforcement.

* IMPROVED ENGINEERED COATINGS FOR AEROSPACE AND NAVAL APPLICATIONS

UND Mechanical Engineering
Technology Applications Group

Award to University: \$34,073 **Private-Sector Match: \$34,560** End Date: June 2016

To further characterize and modify Technology Applications Group's coatings for applications in additional markets.

Results: Technology Applications Group (TAG) has used the information generated from this research to supply technical data sheets to optical manufacturers who are becoming more dependent on their Tagnite coating. This information has helped TAG grow its market share in the optical and UAS fields. The company reported one full time position to help with their growth into optical and UAS markets as a result of the work that was done in the grant project.



STINGRAY: INTEGRATING BEYOND VISUAL LINE OF SIGHT (BVLOS) COMMUNICATIONS CAPABILITY INTO UAS

UND UAS Center of Excellence
Rockwell Collins

Award to University: \$500,000 **Private-Sector Match: \$585,000** End Date: November 2017

To establish a beyond visual line of sight (BVLOS) test capability for civilian unmanned aircraft systems. This flight test effort will utilize the capabilities of the Northern Plains Unmanned Aircraft Systems Test Site.

* EVALUATION OF THE EFFECTIVENESS OF SPORTS VISION PROGRAMS IN IMPROVING PERFORMANCE AND HEALTH IN YOUNG ATHLETES

UND Psychology
Valley Sports Vision

Award to University: \$213,399 **Private-Sector Match: \$217,490** End Date: December 2017

To evaluate the effectiveness of visual software and hardware training for athletes.

Results: Based on the testing and training protocols developed during the study, in September of 2017 the research group formed a startup named ANV Services, LLC (DBA Advanced Neurovision Systems). The purpose of this commercial venture is two-fold: Sports Vision Training of athletes and visual rehabilitation of patients with a history of mild traumatic brain injury (mTBI). Since its inception, it has had a number of referrals of mTBI patients for neurovisual rehabilitation from neuropsychologists, neurologists, optometrists and a neurosurgeon. The services they provide utilize vision therapy techniques approved by the College of Optometrists in Vision Development. Many of these services are covered by patients' insurance plans.

DESIGN AND DEVELOPMENT OF ACCELERATED DEGRADATION TEST METHODOLOGY FOR HYDRO-STATIC SYSTEM

NDSU Industrial & Manufacturing Engineering
Doosan Infracore Construction Equipment

Award to University: \$99,875 **Private-Sector Match: \$99,875** End Date: May 2018

To conduct research that will lead to an integrated and systematic process of designing accelerated degradation test methods for hydro-static and hydraulic systems, and a data analysis module to assess system reliability based on accelerated degradation data.



* APPLIED RESEARCH - WIND TURBINE BLADE INSPECTION TECHNOLOGY APPLICATION

UND Tech Accelerator
EdgeData

Award to University: \$450,000 **Private-Sector Match: \$450,000** End Date: May 2018

To use UAS with high resolution cameras to inspect wind towers and turbines and develop software to convert the images into actionable data.

Results: Edge Data has one employee in Grand Forks. They are a tenant at UND Tech Accelerator. The company is flying missions across the country. BladeEdgeSM is the industry's first software portal that transforms raw data from aerial inspections into actionable intelligence, helping wind farm operators and managers improve wind farm safety and efficiency, ultimately extending infrastructure lifespan and reducing cost. The BladeEdgeSM Capture Assurance Tool (BECAT) is a streamlined software tool for UAV service providers performing aerial inspections. BECAT ensures that data is always captured correctly in the field, decreasing the possibility of human error and ensuring UAV inspectors collect data on every square inch of the infrastructure.

USING UAS IMAGERY TO IDENTIFY WEED INFESTATIONS IN CROPLAND

NDSU Agricultural & Biosystems Engineering
Sentera

Award to University: \$85,500 **Private-Sector Match: \$85,500** End Date: December 2017

To identify weed infestations using sensors on a UAS.

VALUATION OF OPTICAL SENSORS FOR DETECTION AND REMEDIATION OF CROP STRESS IN PRECISION AGRICULTURE

NDSU Agribusiness & Applied Economics
Sentera

Award to University: \$300,000 **Private-Sector Match: \$300,000** End Date: April 2018

To use GPS-enabled sensors mounted on a UAS to conduct rapid mapping of sub-field variations of crop health and provide prescriptive remedies for problem areas.

AVIATION ENTERPRISE RESOURCE PLANNING, COMMUNICATIONS AND CONTROL

NDSU Center for Nanoscale Science & Engineering
SmartC2

Award to University: \$300,000 **Private-Sector Match: \$304,068** End Date: December 2017

To research and develop improvements to light aviation management software that will integrate billing, scheduling, deployment, maintenance and other needs that are currently handled either by paper-based work or different software solutions that are not integrated.



UASs FOR BUILDING ASSESSMENT

UND Mechanical Engineering
PCL Construction

Award to University: \$145,771 **Private-Sector Match: \$159,342** End Date: May 2017

To minimize the amount of labor required to collect important construction site data using a small UAS during the construction process.

ELECTROCHEMICAL GAS-TO-LIQUID TECHNOLOGY DEVELOPMENT

UND Energy & Environmental Research Center
FuelCell Energy

Award to University: \$150,000 **Private-Sector Match: \$150,000** End Date: November 2016

To work on the development of a new electrocatalyst for direct gas-to-liquid conversion of methane gas to methanol.

* DEVELOPING INTUITIVE PARKING SOFTWARE USING HIGH PERFORMANCE COMPUTING

UND Department of Computer Science
FedEx

Award to University: \$314,368 **Private-Sector Match: \$314,368** End Date: May 2017

To use high performance computing capacity and aviation management expertise to develop software with FedEx that will increase efficiencies in loading, unloading and flight operations.

Results: Grand Forks startup, HubEdge, LLC acquired a license from UND for the software developed through this project. They are finalizing an agreement with Fed Ex to provide service and support for this software that maximizes time efficiency in the parking, loading and takeoff of planes at the FedEx hub in Memphis from their Grand Forks location.

CONVERSION OF VEGETABLE OILS TO WAXES, LUBRICANTS, TRANSFORMER FLUIDS, AND LOW-TOXICITY DRILLING FLUIDS

UND Energy & Environmental Research Center
Accelergy

Award to University: \$250,000 **Private-Sector Match: \$250,000** End Date: January 2017

To develop methods to convert vegetable oils to waxes, lubricants, transformer fluids, and low-toxicity drilling fluids. These products will be both environmentally friendly and produced from North Dakota products.



★ **COOPERATIVE AIRSPACE TECHNIQUES AND VISUALIZATION (CATV)
TESTING FOR ENABLING UAS OPERATIONS**

UND Regional Weather Information Center
Harris Corporation

Award to University: \$300,000 **Private-Sector Match: \$313,748** End Date: December 2017

The first project developed techniques, devices and methods to aid in a risk and safety assessment for performing beyond-visual-line-of-sight (BVLOS) UAS operations supported by Ground Based Detect And Avoid (GBDAA) capabilities. For the second project, Harris licensed technology developed in the CATV project and is using it in its RangeVue software.

Results: The development of this Automatic Dependent Surveillance – Broadcast (ADS-B) network has UND, Harris Corporation and the Northern Plains UAS Test Site at the forefront of BVLOS flight operations for commercial UAS. UND and Harris received an additional Research ND grant to continue development and testing of this network. Through its work in North Dakota, Harris has also developed a partnership with Appareo Systems in Fargo.

**LARGE-SCALE UAS DATA COLLECTION, PROCESSING AND MANAGEMENT
FOR FIELD CROP MANAGEMENT**

NDSU Agricultural & Biosystems Engineering
Elbit Systems of America

Award to University: \$357,546 **Private-Sector Match: \$357,546** End Date: May 2017

To collect crop data using infrared, thermal, color and multi-spectral sensors on both large and small UAS. This data will then be compared to available satellite imagery and ground data collected using similar sensors. The analysis will be done by NDSU's Center for Computationally Assisted Science and Technology (CCAST).

★ **UAS SENSOR PAYLOAD DEVELOPMENT FOR RESCUE OPERATIONS**

NDSU Electrical & Computer Engineering
Cyclops Technologies

Award to University: \$291,784 **Private-Sector Match: \$292,864** End Date: September 2017

To miniaturize a through-the-wall sensor (TTWS) payload that can be operated from a small UAS. The product was eventually reduced down from 100 pounds to a 3-pound sensor.

Results: NDSU took a 100 pound TTWS system for detecting motion of people behind barriers for search and rescue operations and developed a miniature version that weighs 3 pounds. CYCLOPS wanted to have this sensor small enough to be carried as a payload that by a UAS. The prototype has attracted the interest of a Montana company named Flat Earth Sensing Solutions. They have expressed an interest in partnering to further develop the detection range of the system. CYCLOPS is in discussions with NDSU to open an office on campus.



DETERMINING CROP HARVEST READINESS USING UAV AND THERMAL INFRARED SENSORS

NDSU Research Extension Center in Carrington
IntelinAir

Award to University: \$62,291 **Private-Sector Match: \$62,291** End Date: March 2018

To use thermal infrared sensors mounted on a UAS to collect high-resolution imagery to determine the harvest readiness of crops in the field.

DEVELOPMENT OF WIRELESS ENERGY TRANSFER WITHIN THE HUMAN BODY

NDSU Electrical & Computer Engineering
Boston Scientific

Award to University: \$40,000 **Private-Sector Match: \$40,000** End Date: October 2016

To work on the development of a rechargeable, wireless pacemaker for human hearts.

POWERLINE COMPONENT FAILURE IDENTIFICATION – UAS

UND John D. Odegard School of Aerospace Sciences
Minnkota Power Cooperative and Border States Industries

Award to University: \$300,000 **Private-Sector Match: \$605,855** End Date: December 2018

To use unmanned aircraft systems as a tool to conduct aerial inspections of high voltage power lines to aid in the determination of necessary maintenance and repairs.

APPLICATION OF UNMANNED AERIAL SYSTEMS (UAS) TO ELECTRIC DISTRIBUTION INFRASTRUCTURE DAMAGE ASSESSMENT AND RESTORATION

UND Center for Innovation
Xcel Energy and Elbit Systems of America LLC

Award to University: \$499,981 **Private-Sector Match: \$558,498** End Date: June 2018

To assess the feasibility of applying high and low-altitude unmanned aerial system (UAS) technology coupled with advanced data modeling and analysis to improve electric distribution infrastructure damage assessment and restoration capabilities following a natural disaster.

COHERENT BACKSCATTERING OF CLOUD PARTICLES

UND Atmospheric Sciences
Rosemount Aerospace, Inc

Award to University: \$300,000 **Private-Sector Match: \$300,000** End Date: June 2019

Refinement of newly developed instruments that detect high ice concentrations in the air on commercial aircraft.



EVALUATION OF COMMERCIALY PRODUCED ICE NUCLEI

UND Atmospheric Sciences
Weather Modification, Inc

Award to University: \$111,770 **Private-Sector Match: \$111,770** End Date: October 2019

Development of a cloud-nuclei injection system and use of that system to deliver cloud seeding material from burning flares into a cloud chamber to determine ice nuclei activation temperatures and improve cloud seeding techniques and materials for this company.

MANAGEMENT AND MONITORING OF PSORIASIS AND MELANOMA PATIENT TREATMENT USING SMARTPHONES

UND Electrical Engineering
Spectral Molecular Imaging, Inc. (SMI) & eTreat Medical Diagnostics, Inc.

Award to University: \$300,000 **Private-Sector Match: \$300,000** End Date: December 2019

Development of a tool and computer algorithms that will allow melanoma and psoriasis patients to share images, captured with their mobile devices, with their physicians for the purpose of monitoring the progression of these diseases.

* ENABLING UAS OPERATIONS THROUGH SUPPORT OF A UAS NETWORK INFRASTRUCTURE

UND Regional Weather Information Center
Harris Corporation

Award to University: \$500,000 **Private-Sector Match: \$502,956** End Date: December 2018

To research and develop safe, affordable and scalable beyond visual line of sight (BVLOS) unmanned aircraft system (UAS) network solution for civil applications with the software that Harris Corporation is developing.

Results: Harris licensed technology developed in the CATV project and is using it in its RangeVue software. Use of this software is a major component of developing a safe, affordable, and scalable network solution for civil applications. The vision is to develop a network that will enable statewide commercial BVLOS flight.

DESIGN AND DEVELOPMENT A LOW-COST, HIGH RELIABILITY, HIGH ACCURACY IMU

NDSU Computer Science
Axelo, Inc.

Award to University: \$103,458 **Private-Sector Match: \$103,500** End Date: August 2018

Design and develop a low-cost, high reliability and high accuracy inertial measurement unit (IMU). These sensors will be used in unmanned aircraft systems (UAS) and autonomous vehicles.



OPTIMIZATION OF CYCLOHEXASILANE (CHS) PRODUCTION FROM TRICHLOROSILANE

NDSU Chemistry and Biochemistry
3DIcon Corporation

Award to University: \$150,000 **Private-Sector Match: \$150,000** End Date: June 2018

To improve the yield and purity of the key intermediate required for an economical synthesis of cyclohexasilane (CHS), an efficient ingredient for making a variety of commercially important silicon based materials including silicon quantum dots, silicon nanowires, silicon nanorods, amorphous and nanocrystalline silicon, thin films of silicon and materials for lightweight batteries and lightweight solar cells.

ADDITIVE MANUFACTURING FOR MATTRESS COMFORT CUSTOMIZATION

NDSU Industrial and Manufacturing Engineering
Comfort King

Award to University: \$32,000 **Private-Sector Match: \$32,000** End Date: May 2018

To study sleeping posture, digitize this information for individual users and use this information to design mattresses with variable stiffness that will be manufactured for the customer based on this information.

CONVERTING UAS-ACQUIRED THERMAL IMAGES INTO HEAT LOSS COST ASSESSMENTS FOR INFRASTRUCTURE ASSESSMENT

UND Office of Research and Economic Development
SkySkopes, Inc.

Award to University: \$431,983 **Private-Sector Match: \$449,080** End Date: November 2018

To collect energy audit data on NDUS buildings using a small UAS and thermal sensors, and show that it is more cost effective than having people collect this data by hand, then develop the technological capability to convert thermal imaging of infrastructure into usable cost data.

ALTAIR: PREVENTION AND TREATMENT OF PRESSURE ULCER USING A SMART SEATING SYSTEM

UND Electrical Engineering
MobiSafe Systems, Inc. & Comdel Innovation, Inc.

Award to University: \$178,000 **Private-Sector Match: \$258,000** End Date: September 2020

To develop a commercially viable seating system for preventing/healing of pressure ulcers. A prototype exists. The design will be improved by including pressure distribution on the seating area and incorporating other features such as pressure alternation and pressure relief. This will include sensors that will monitor the seating condition of the patient.

FAST TRACK

1:1 Match Required

FAST Track is a subprogram of Research ND. Proposals must meet a compelling private sector need, be of short duration (no more than one year), and provide a compelling reason to begin immediately. These smaller grants are approved administratively and may not exceed \$50,000. The matching funds for Fast Track must be cash.

PRODUCE GREEN CONCRETE FROM FLY ASH WASTE

NDSU Civil & Environmental Engineering

Award to University: \$15,000 **Private-Sector Match: \$15,000** End Date: August 2016

To generate a green geopolymer concrete with fly ash from North Dakota coal-fired power plants and optimize the strength and cure time for construction purposes.



RESEARCH ND BIO AWARDS

1:1 Match Required
2017-2019 Proposed Funding

Research ND Bio has the same intent as Research ND but is limited to the development and commercialization of vaccines and antibodies for the prevention of, treatment of, or cure for cancer; virally infections disease; or other pathogens, including bacteria, mycobacteria, fungi and parasites.

RESEARCH, DEVELOPMENT AND COMMERCIALIZATION OF PARVOONE

UND School of Medicine & Health Sciences
Avianax

Award to University: \$1,000,000 **Private-Sector Match: \$1,000,000** End Date: December 2015

To assist in the research, development and commercialization of novel therapeutic for parvovirus infection in puppies and dogs. Field trials of the K-9 Parvovirus Antibody Therapeutic Treatment showed a 90% success rate in treating parvo virus in dogs. Additional testing is underway and quality control is being monitored to ensure that the end product is consistent. Avianax anticipates launching ParvoOne in spring 2017.

RESEARCH AND DEVELOPMENT OF IMMUNOTHERAPEUTIC AND VACCINE CANDIDATES FOR PORCINE EPIDEMIC DIARRHEA VIRUS (PEDV)

UND School of Medicine & Health Sciences
Zyme Fast

Award to University: \$396,622 **Private-Sector Match: \$403,400** End Date: December 2017

To support the verification of target antigen proteins developed for a vaccine capable of producing PEDV neutralizing antibodies in immunized sows or egg yolk antibodies in hens. The express antigen will be isolated, purified and used for vaccine production.

STRUCTURAL CHARACTERIZATION OF CANDIDA VACCINES

UND School of Medicine & Health Sciences
NovaDigm Therapeutics

Award to University: \$45,712 **Private-Sector Match: \$45,712** End Date: August 2016

To develop and implement mass spectrometry-based methodologies to monitor lot-to-lot consistency and identify critical quality attributes (CQAs) of NovaDigm vaccine antigens related to treating Candidemia.



DEVELOPMENT OF THERAPEUTIC IG FOR INFLUENZA A: POTENTIAL IN POULTRY, CANINE AND HUMAN MARKETS

UND School of Medicine & Health Sciences
Avianax

Award to University: \$1,000,000 **Private-Sector Match: \$1,055,850** End Date: November 2017

To develop anti-influenza A virus antibodies for the treatment of flu in poultry, dogs and humans using therapeutic goose antibodies.

RD&C OF ANTIBODY THERAPY FOR METABOLIC STIMULATION IN ANIMALS

UND School of Medicine and Health Sciences
Zyme Fast LLC

Award to University: \$1,000,000 **Private-Sector Match: \$1,000,000** End Date: January 2019

To develop a method to utilize avian antibodies to induce more rapid weight gain, and therefore, shortened time to market for hogs.



RESEARCH ND VENTURE GRANTS

Match Requirement Varies Based on Phase of Award

The Research ND Venture Grant Program is designed to help move university-developed technology into the marketplace through startup or spinout companies. It provides seed grants and matching funds to facilitate startup and spinout companies' use of university technology.

PHASE I – NO MATCH REQUIRED

This grant phase is used to determine the feasibility of building a business around university developed technology.

REDUCTION OF GAS FLARING BY ADVANCED SEPARATION AND STORAGE

UND Institute for Energy Studies, Petroleum Engineering

Award to University: \$100,000 End Date: August 2015

To address the feasibility and market potential of using sorbent technology for the separation and storage of natural gas and lean gas as an alternative to flaring in the Bakken. A novel flare gas capture technology called Advanced Separation and Storage (ASSTTM) was developed in partnership with Envergen. Through this process, natural gas liquids (NGLs) are recovered from flare gas from the Williston Basin. Preliminary results show more than 85% of the NGLs can be recovered to give an NGL product that is more than 90% pure and a lean gas product that is more than 95% pure. The successful commercialization of this process is dependent on the price of oil.

EVALUATION OF ANTI-FOULING COATINGS FOR FRESH WATER ZEBRA MUSSELS

NDSU Center for Surface Protection

Award to University: \$99,523 End Date: September 2016

To address the feasibility and market potential of utilizing anti-fouling coatings as a means to mitigate colonization of underwater structures, such as municipal and industrial water intake pipes, by zebra mussels.



RATIONAL ANTIGEN DESIGN FOR PORCINE CIRCOVIRUS STRAIN 2 (PCV2) VACCINES AND DIAGNOSTICS

NDSU Veterinary & Microbiological Sciences

Award to University: \$99,995 End Date: June 2018

To further develop a vaccine and immunoassay for PCV2, one of the viruses involved in the Porcine Respiratory Disease Complex (PRDC).

HONING IN ON "EFFECTIVE" ANTIBODY RESPONSES TO ENHANCE PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME VIRUS (PRRSV) PROPHYLAXIS

NDSU Veterinary & Microbiological Sciences

Award to University: \$99,965 End Date: June 2018

To further develop a vaccine and immunoassay for PRRSV, the single most important infectious cause of economic losses to the pork industry.

PROOF OF CONCEPT CLOUD CONDENSATION NUCLEUS COUNTER FOR UNMANNED AIRCRAFT SYSTEMS

UND Atmospheric Sciences

Award to University: \$99,739 End Date: May 2016

To develop a miniaturized cloud condensation nucleus counter for deployment on unmanned aircraft systems. A prototype of the CCN counter has attracted interest of two potential private sector partners. Both are in discussions with regarding the possible ongoing testing and future commercialization of the CCN counter.

DEVELOPMENT OF AN INTELLIGENT SELF-ORGANIZING ELECTRODE STIMULATION DELIVERY NETWORK

NDSU Electrical & Computer Engineering

Award to University: \$100,000 End Date: July 2015

To test a lead-less and battery-less electrode that was designed to provide electronic stimuli to the heart in cardiac resynchronization therapy (CRT). Successful testing of a lead-less and battery-less electrode that was designed at NDSU to provide electronic stimuli to the heart in cardiac resynchronization therapy (CRT) led to a collaborative effort and with Boston Scientific Corporation to test this technology in the development of wireless pacemakers for human hearts.



MATERIAL COMPOSITIONS FOR ARTIFICIAL BONE FABRICATION

NDSU Industrial & Manufacturing Engineering

Award to University: \$99,214 End Date: December 2015

To further develop the ability to replicate specific human bone using 3D printing. The project will address the feasibility and market potential of producing human bone with specific characteristics (e.g. age, gender, bone density) for use in research settings.

NANOSPHERES TO PROVIDE COMMERCIALY IMPORTANT NEW PROPERTIES TO PAINTS AND COATINGS

NDSU Coatings & Polymeric Materials

Award to University: \$100,000 End Date: December 2016

To address the feasibility and market potential of the use of nanospheres in paints and coatings to increase the anti-corrosion properties of the paint when applied to metal.

DEVELOPMENT OF GLIOMA PROGNOSIS KIT

UND School of Medicine

Award to University: \$100,000 End Date: September 2016

To develop a kit for the stratification of patients diagnosed with glioma for personalization of medical treatment.

REMOVAL AND RECOVERY OF PHOSPHATE FROM EUTROPHIC LAKES AND WASTEWATER AND USE OF RECOVERED PHOSPHATE AS A FERTILIZER

NDSU Civil & Environmental Engineering

Award to University: \$100,000 End Date: December 2017

To address the feasibility and mark of potential of iron cross-linked alginate beads for phosphate removal from water bodies and the subsequent use of the phosphate containing beads as a slow release fertilizer.

PUSH-BUTTON ADHESION CONTROL

NDSU Materials & Nanotechnology

Award to University: \$99,985 End Date: December 2016

To create a demonstration device for an adhesive technology that can be switched on and off with the push of a button.



DEVELOPMENT OF INHIBITORS TARGETING GAMMA-HERPES VIRUSES

NDSU Chemistry & Biochemistry

Award to University: \$100,000 End Date: June 2016

To address the feasibility and market potential of the use of inhibitor of gamma herpes viruses as a potential therapeutic agent. The Epstein-Barr virus (a gamma herpes virus) is one of the most common viruses in humans. It is the causative agent of infectious mononucleosis and is associated with several forms of cancer including Hodgkin's lymphoma, Burkitt's lymphoma and nasopharyngeal carcinoma.

* SENSING EARTH ENVIRONMENT DIRECTLY (SEED SENSOR)

NDSU Mechanical Engineering

Award to University: \$99,969 End Date: December 2015

To address the feasibility and market potential of new sensor technology to directly measure the soil environment. The sensors would be deployed during planting and are produced from renewable environmentally-safe materials. SEED sensors were manufactured and run through field trials that consisted of five different soil types and three different crops. Additional field trials are underway on golf courses.

Results: A Venture Grant Phase II was awarded to NDSU with Fargo startup c2sensor Corporation, to further develop and refine the capabilities of the SEED sensor and take the product from field trials to commercial use.

NOVEL ANTI-INFLAMMATORY DRUGS FOR TREATING ALZHEIMER'S DISEASE

UND School of Medicine

Award to University: \$100,000 End Date: December 2016

To develop a safe, effective drug to treat the inflammatory conditions of Alzheimer's disease that contribute to disease progression.

DEVELOPMENT OF A MOBILE MEDICAL APPLICATION FOR THE ANALYSIS OF HAND ARTHRITIS

UND Electrical Engineering

Award to University: \$100,000 End Date: June 2018

To further develop a method to use a mobile application to measure and monitor anatomical changes to a hand relating to arthritis. Information from the mobile app would be shared with the patient's health care provider to assist with their treatment.



DEVELOPMENT OF MICRO COLD SPRAY PRINT SYSTEM

NDSU Center for Nanoscale Science & Engineering

Award to University: \$100,000 End Date: December 2017

To further develop a cold spray tool for applications such as flexible printed electronics and solar cells.

COMMERCIAL FEASIBILITY OF NOVEL RENEWABLE BASED POLYAMIDE THERMOPLASTICS

NDSU Center for Nanoscale Science & Engineering

Award to University: \$100,000 End Date: November 2016

To study the commercial feasibility of producing novel high temperature polymers based on furandicarboxylic acid (FDCA) for use as engineering thermoplastics.

NEW RENEWABLE POLYMERS FROM PLANT/VEGETABLE OILS

NDSU Coating & Polymeric Materials

Award to University: \$99,989 End Date: April 2018

To enable production of high-value and high-profit specialty polymers from vegetable oils.

A NEW DESIGN TO IMPROVE LIFE EXPECTANCY OF TOTAL ANKLE REPLACEMENT

NDSU Mechanical Engineering

Award to University: \$99,995 End Date: December 2017

To develop an improved prosthesis design that addresses the major limitations of current total ankle replacement approaches.

RADIO FREQUENCY WIRELESS POWER FOR INDUSTRIAL SENSORS

UND Electrical Engineering

Award to University: \$100,000 End Date: June 2018

To demonstrate a proof-of-concept of wirelessly powering industrial sensors through radio frequency at a distance and prototyping a power reception module system for industrial sensors.

DEVELOPMENT OF REMOTE PATIENT MONITORING SYSTEM - VITA WIPS

UND Electrical Engineering

Award to University: \$100,000 End Date: February 2018

To develop and commercialize a heart monitoring system using smartphones with no battery on the sensors side and no wire connection.



CONTINUED DEVELOPMENT OF COMMERCIALIZATION OF QUALITY CHARACTERIZATION TECHNOLOGY FOR 3D PRINTING

UND Computer Science

Award to University: \$99,954 End Date: December 2017

To develop a technology that will characterize the performance of in-process 3D printing.

TUNABLE POWER AMPLIFIER FOR SMARTPHONES

NDSU Electrical & Computer Engineering

Award to University: \$100,000 End Date: December 2017

To develop a power amplifier for mobile phones that eliminates today's key challenges of cost, size and battery power.

PRODUCTION OF MODIFIED SILICON QUANTUM DOTS FOR SENSOR APPLICATIONS

NDSU Chemistry & Biochemistry

Award to University: \$100,000 End Date: October 2016

To develop modified forms of silicon which are free of contaminants such as heavy metals and toxic nonmetals that can be used as sensors and diagnostic tools in commercial applications.

* BUSINESS FEASIBILITY ASSESSMENT CENTERED ON HIGH PERFORMANCE SPIDER SILK PRODUCTION

NDSU Department of Pharmaceutical Sciences

Award to University: \$100,000 End Date: February 2017

To develop an artificial spinning device that mimics a spider's natural spinning system for the commercial production of tunable silk fibers.

Results: Brooks Biomimetics, LLC, is a newly launched a startup in Fargo and has established an office there. They are continuing to develop both this concept along with another from a related Venture Grant Phase I that they were awarded. They have received a National Science Foundation Early-Concept Grants for Exploratory Research (NSF EAGER) on this project and have plans to submit a large NSF grant to refine and commercialize this technology.



SMARTSEALZ: PILOT/OPERATOR NAVIGATION AUGMENTATION AND PHYSIOLOGICAL MONITORING HEADSET

UND Electrical Engineering

Award to University: \$100,000 End Date: July 2018

To develop a modified aviation headset which will measure physiological data from the operator and deviations in the planned route to provide warnings to the operator via tactile feedback.

TECHNICAL AND ECONOMIC FEASIBILITY ANALYSIS OF NEXT GENERATION VALLEY CITY STATE UNIVERSITY HEATING PLANT

UND College of Engineering & Mines Institute for Energy Studies

Award to University: \$99,987 End Date: February 2017

To develop the technical and economic feasibility of the patented process of integrating activated carbon production within the steam generation heating plants operating at the North Dakota University System campuses.

GRAPHENE-BASED NEAR-INFRARED FLUORESCENT QUANTUM DOTS FOR BIODETECTION AND BIOIMAGING

UND Chemistry

Award to University: \$100,000 End Date: February 2017

To develop a new technique to make a series of novel graphene-based near-infrared fluorescent (NIRF) quantum dots (GQDs) for sensitive detection and imaging of a variety of biomedical samples.

ELECTROMAGNETIC INDUCIBLE DIGITAL PROTEIN EXPRESSION SWITCH OR EMID PROSWITCH

NDSU Electrical & Computer Engineering

Award to University: \$100,000 End Date: June 2018

To refine the use of radio frequency to induce gene expression which has the potential to generate profound changes in the biotech and drug delivery fields, and revolutionize medical treatment.

DEVELOPMENT OF INTELLIGENT INTEGRATED NETWORKS FOR RAPID PIPELINE DAMAGE DETECTION AND HEALTH MONITORING

NDSU Civil & Environmental Engineering

Award to University: \$100,000 End Date: June 2018

To develop a network of sensors for the effective and rapid pipeline damage detection and health monitoring.



DEVELOPMENT OF NOVEL ANTI-MICROBIAL MATERIALS FOR CLINICAL AND FOOD PROCESSING APPLICATIONS

NDSU Veterinary & Microbiological Sciences

Award to University: \$100,000 End Date: December 2018

To develop materials with biofilm inhibiting properties that can be used in multiple applications, including medical devices and food processing.

DEVELOPMENT OF NEXT GENERATION AGRICULTURAL SOIL AMENDMENTS

UND Civil & Chemical Engineering

Award to University: \$93,661 End Date: July 2017

To develop and experiment with a novel carbonaceous bio-soil amendment (CSA) from biomass (renewable) resources that will retain nutrients and act as a controlled-release form of nitrogen and phosphorus.

2,3-BUTANEDIOL PRODUCTION VIA FERMENTATION, AN ALTERNATIVE ROUTE TO CHEMICAL SYNTHESIS, USING SYNTHESIS GAS FROM LIGNITE COAL GASIFICATION

UND Chemical Engineering

Award to University: \$100,000 End Date: August 2018

To refine a process to convert syngas, from lignite coal gasification, into 1,3-Butadiene (1,3-BD) which is used in the production of rubber and nylon.

UNMANNED AIRCRAFT SYSTEM (UAS) SUPPORT TO ENVIRONMENTAL ASSESSMENTS FOR INDUSTRY APPLICATIONS

UND Biology

Award to University: \$93,661 End Date: June 2018

To develop automated aerial survey methods for use in environmental study applications.

COMMERCIALIZATION OF NOVEL LIGNIN REINFORCED BIOPLASTICS BY USING GAME CHANGING ADDITIVE MANUFACTURING PRACTICES

UND Mechanical Engineering

Award to University: \$99,852 End Date: December 2018

To develop specialized products by using sustainable and novel bioplastics.



SOY BASED ROAD DUST SUPPRESSANT SCALE UP AND FIELD TESTING

NDSU Office of Research and Creative Activity

Award to University: \$100,000 End Date: December 2018

To further develop an environmentally friendly dust suppression agent for gravel roads that is derived from waste glycerol and soybean oil.

AN INNOVATIVE APPROACH TO HEAL NONUNION BONE DEFECTS IN HUMANS

NDSU Civil & Environmental Engineering

Award to University: \$100,000 End Date: August 2018

To develop a scaffold material using novel biomaterials that can be used for bone tissue regeneration in large (non-union) breaks of human bones.

NEW SUSTAINABLE CONCRETE FOR NORTH DAKOTA

NDSU Civil & Environmental Engineering

Award to University: \$72,250 End Date: December 2017

To develop methods for promoting partial replacement of Portland limestone cement with fly ash in concrete.

LOW-COST SELF-COOLING FOR MICROCHIPS USING ADVANCED COMPOSITE COATING

NDSU Electrical and Computer Engineering

Award to University: \$100,000 End Date: August 2018

To develop a novel low-cost self-cooling technology using advanced phase change materials based on graphite composite to passively control thermal transport in computer microchips.

DEVELOPMENT OF A NOVEL CARBON ADSORBENT FOR REMOVAL OF PHARMACEUTICALS, HERBICIDES AND OTHER EMERGING CONTAMINANTS FROM DRINKING WATER

UND Civil Engineering and Chemistry

Award to University: \$84,890 End Date: June 2018

To develop and experiment with a novel oxidized carbon adsorbent, produced from agricultural biomass that can remove contaminants from drinking water in a cost-effective manner.



DISCOVERY AND DEVELOPMENT NEW CANCER THERAPEUTIC DRUGS VIA INHIBITING D5D AND TARGETING OVER-EXPRESSED COX-2

NDSU Department of Pharmaceutical Sciences

Award to University: \$100,000 End Date: August 2018

To develop a new drug entity (NDE) that can effectively inhibit delta-5-desaturase (D5D) as a new type of cancer therapy.

DETECTION OF BLOCKAGE IN PETROLEUM PIPELINES

UND Petroleum Engineering

Award to University: \$99,932 End Date: August 2018

To apply mathematical models to data from sensors in petroleum pipelines to determine the location and severity of blockages that may exist including blockage section diameter and length. Specific work will be done on detecting blockage in parallel/looped pipelines, differentiating between single blockages from multi-blockages.

* ASSESSING THE CLINICAL FEASIBILITY AND FDA APPROVAL PATHWAY FOR A NEW ANTIMICROBIAL BONE FILLING PUTTY

NDSU Department of Pharmaceutical Sciences

Award to University: \$100,000 End Date: March 2018

Develop an antibiotic releasing, biodegradable putty to be used as a bone void filler that will reduce infection associated with surgically or traumatically induced orthopedic defects.

Results: Brooks Biomimetics, LLC, is a newly launched a startup in Fargo and has established an office there. They have made significant progress on the bone void filling putty. They have met with two potential investors, expanded their patent position to include a packaging and delivery device for the putty, applied for additional (federal) funding, hired an FDA consultant to assist in the approval process, formed collaborative partnerships with large animal surgeons for testing and identified a world class orthopedic surgeon at UCLA to act as our clinical advisor.

DEVELOPMENT OF LOW-COST PORTABLE EMBEDDED DEVICE FOR WELDING QUALITY MONITORING

NDSU Electrical and Computer Engineering

Award to University: \$100,000 End Date: April 2018

Development of a low-cost portable embedded device to support advanced machine learning algorithms for real-time welding image processing. This could give immediate feedback to a welder to let them know if their welds will pass inspection by a certified weld inspector.



ULTRA HIGH DENSITY POWER CONVERSION SYSTEMS USING GALLIUM NITRIDE POWER DEVICES

NDSU Electrical and Computer Engineering

Award to University: \$100,000 End Date: August 2018

To develop a gallium nitride (GaN) based power converter that provides high efficiency and high-power density that is more efficient than current silicon power semiconductor devices.

AN INTEGRATED SOFTWARE PACKAGE FOR DATA PROCESSING, MODELING AND SIMULATION OF UNCONVENTIONAL RESERVOIRS

UND Petroleum Engineering

Award to University: \$100,000 End Date: March 2018

To assess the business potential for a user-friendly, interactive software package suitable for performing data processing, modeling and simulation of unconventional shale oil reservoirs in North Dakota. Current commercial software used in industry may not accurately simulate the complex dynamics in shale formations since it does not consider the differences between organic and inorganic matter or treat natural fractures accurately.



PHASE I/II – MATCHING FUNDS REQUIRED FOR SECOND PHASE

This grant phase is used when a university has already found a private sector partner and can work seamlessly through Phase I and Phase II. Matching funds are required for the second phase of the project.

PROCESS AND APPLICATION RESEARCH AND DEVELOPMENT FOR SOY-BASED MATERIALS FOR INDUSTRIAL APPLICATIONS

NDSU Coatings & Polymeric Materials

Award to University: \$200,000 **Private-Sector Match: \$150,000** End Date: March 2017

To scale up production of novel resins and polymers derived from plant oils and sugars for commercial use.

* A LOW COST AND REPRODUCIBLE SYNTHETIC PROCEDURE FOR MASS PRODUCTION OF LITHIUM ION BATTERIES

UND College of Engineering & Mines - Institutes for Energy Studies
Clean Republic, LLC

Award to University: \$148,105 **Private-Sector Match: \$98,883** End Date: March 2017

To develop a low cost, environmentally benign, reproducible and up-scalable synthetic procedure for lithium iron phosphate (LFP) cathode material for the improved performance in its lithium battery packs.

Results: The technology that they have developed has attracted the interest of a Swedish investment group that has approved a \$1.5 million investment to Clean Republic on the LFP powder project and the relevant Dakota Lithium Battery production. This will allow them to move from assembly only to production of the materials and assembly of the batteries in their Grand Forks location. That change will result in growth of their Grand Forks workforce.

PHASE II – 1:1 MATCH REQUIRED

This grant phase is used to launch a startup or spinout company with technology that was proven in Phase I.

SENSING EARTH ENVIRONMENT DIRECTLY (SEED SENSOR)

NDSU Mechanical Engineering
c2sensor

Award to University: \$150,000 **Private-Sector Match: \$150,000** End Date: October 2018

To continue developing the SEED Sensor to directly monitor the soil environment. In its final form, the SEED Sensor will be the size of an acorn and developed from both bio-based and bio-inert materials.



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